

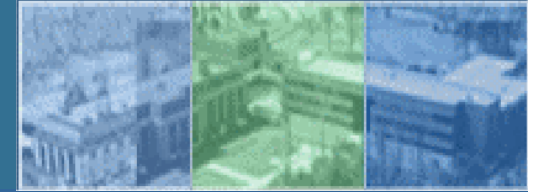
TFHRC Technology and Innovation Fair 2008

NDE Lab Support Contract

presented
by
Frank Jalinoos

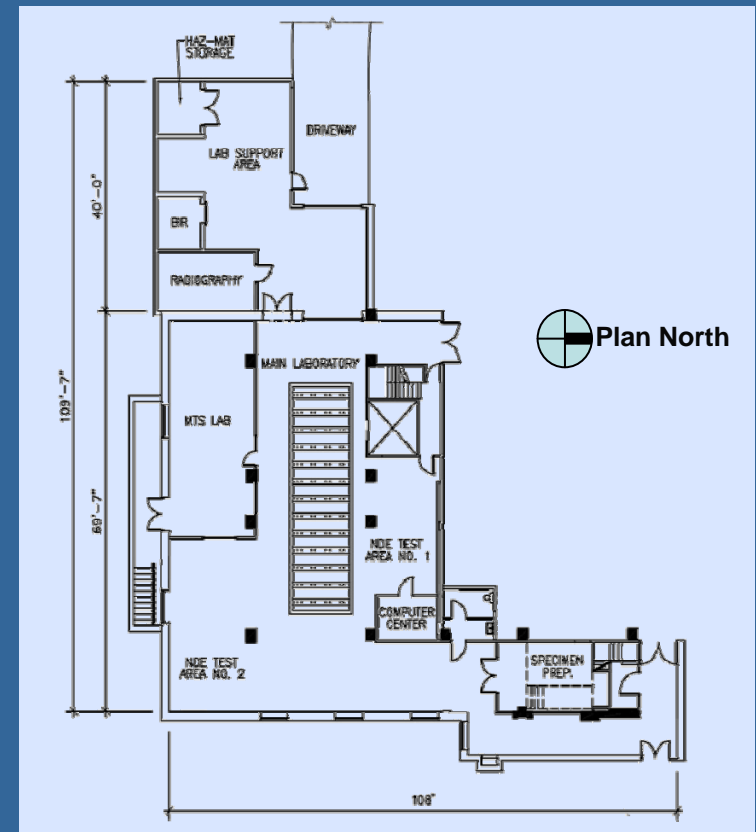


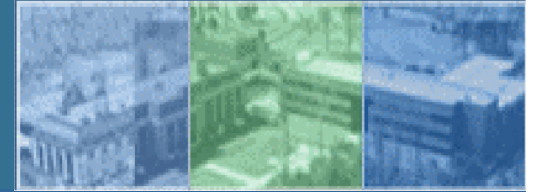
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What tools/resources do we use?

- Structural Loading Facilities –
 - Reaction Test Loading Floor
 - MTS Loading Frames
- Instrumentation / Monitoring Lab
- Computer Lab
- Radiography Lab
- Control Specimen Storage
 - Specimen Room (12' x 20') – Temperature and Humidity Controlled
 - Enclosed - Minimal Temperature Control
 - Open-Air - Outside, N. of Structures Lab.
- Equipment Storage / Reference Library
- Field Vehicles (*2 Vans, 1 Box-Truck, 1 Trailer*)





In-Service Test Bridges

1. Route-One Bridge - 1,100' in length,
8-steel beam spans with a bare concrete deck. Built
1975 – heavy truck traffic.
2. Carter Creek Bridge – 288' in length,
5-steel beam spans with a bare concrete deck.
Moderate traffic.
3. Van Buren Bridge – 180' in length,
3-steel beam spans with a bare concrete deck. Built
in 1963 – low traffic.



US Route-One Bridge

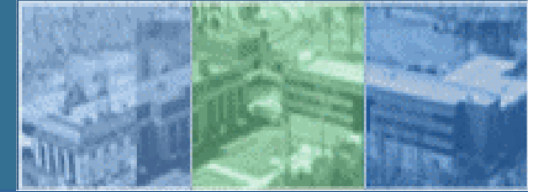


View of Deck on Carter Creek Bridge



Elevation View of Van Buren Road Bridge

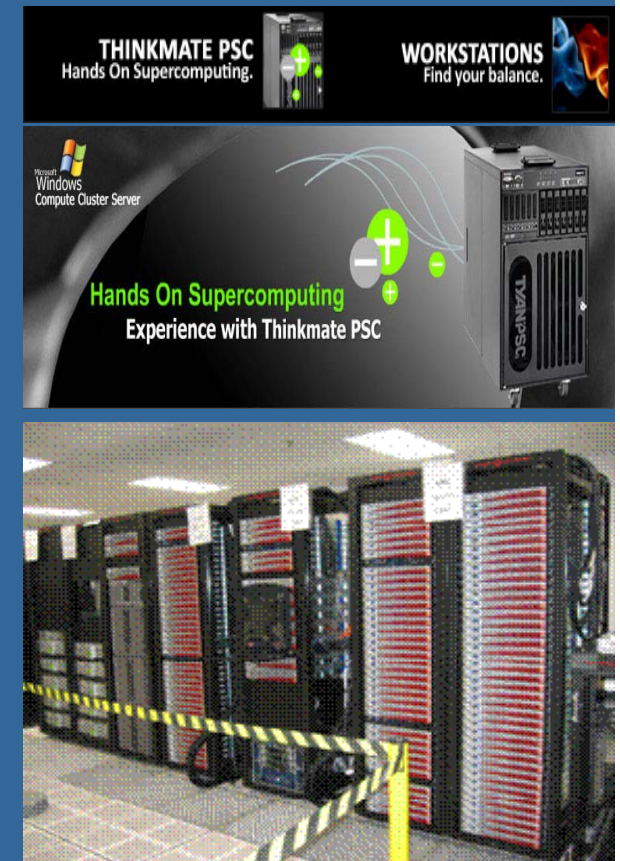




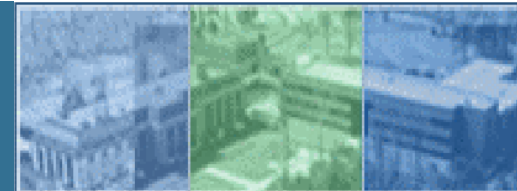
What tools and Resources are unique to TFHRC?

- Computing Hardware Facilities –
 - 2 Thinkmate parallel computers
 - Each with 16 processors and high-end graphics
 - Connections to TRCC/ANL cluster (extensive simulation)
- Advanced Application Software –
 - LSDYNA, FEMAP Nonlinear FE analysis and simulation
 - COMSOL Multiphysics Research for NDE/NDT Validation

... For Advanced NDE Tools, please
Refer to Project Demos!

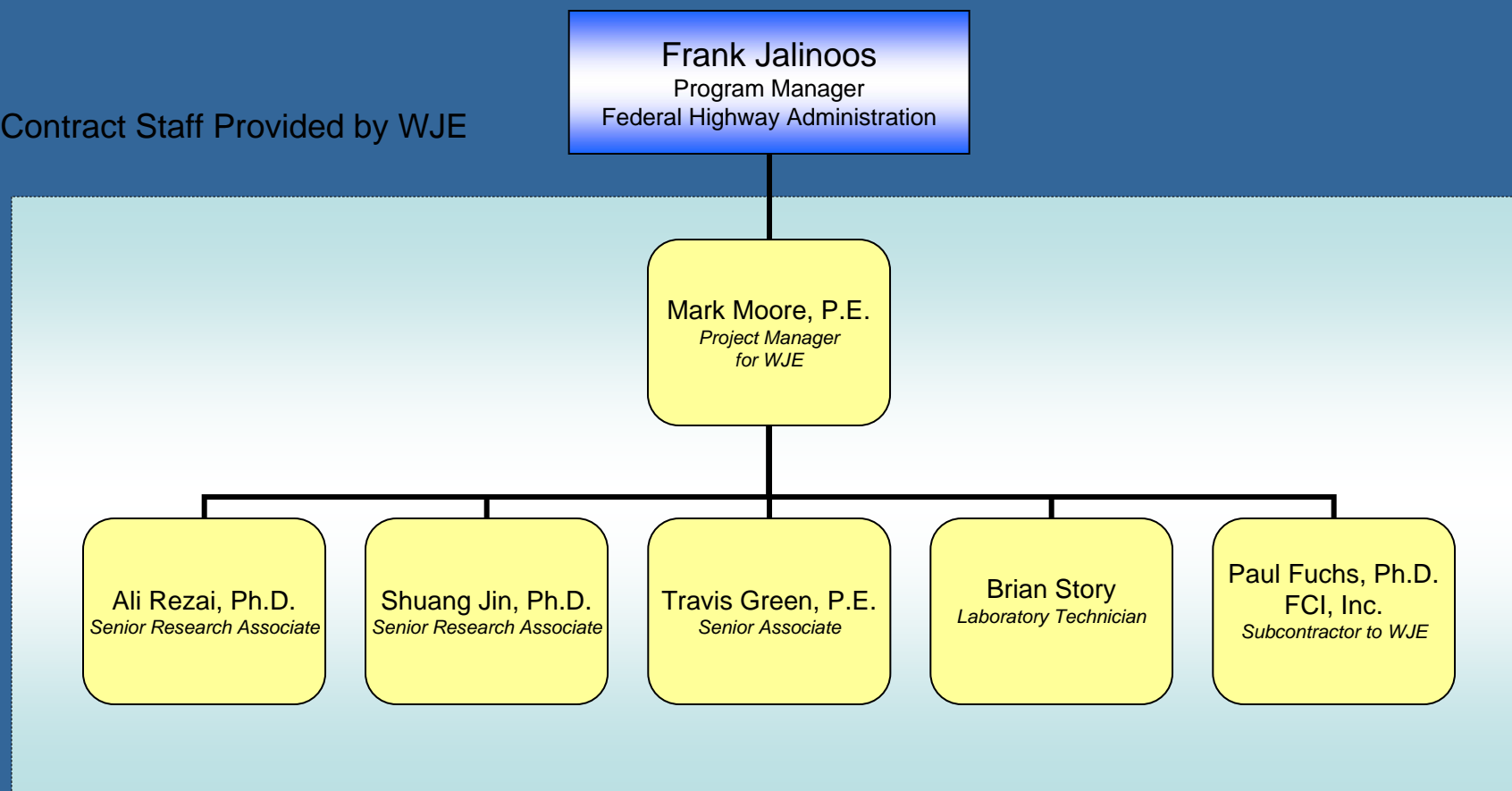


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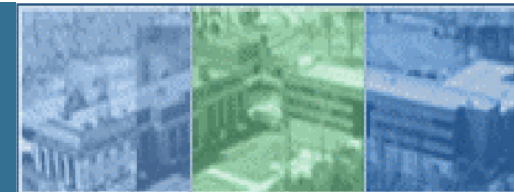


FHWA NDE Center

Contract Staff Provided by WJE



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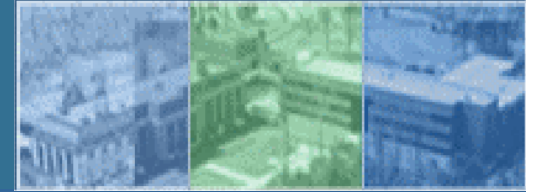
NDE Staff Scientific Expertise

Laboratory Staff	Frank Jalinoos	Mark Moore	Shuang Jin	Ali Rezai	Paul Fuchs	Travis Green	Ralf Arndt
Ground Penetrating Radar (GPR)	✓		✓	✓	✓		✓
Impact Echo / Concrete Ultrasonics	✓	✓		✓		✓	✓
SASW /MASW	✓						
Crosshole Sonic Logging (CSL) / Gamma-Density/Ultrasonic tomography	✓						
Radiography			✓				✓
Steel Ultrasonics	✓	✓	✓	✓	✓	✓	
Infrared Thermography		✓			✓		✓
Eddy Current	✓			✓	✓	✓	
Foundation NDE	✓						
Parallel Seismic and Borehole Methods	✓						
Structural Health Monitoring / Smart Systems	✓		✓				
Instrumentations		✓			✓		✓
Numerical Modeling	✓		✓				✓
Structural Testing		✓			✓	✓	
Field Testing	✓	✓	✓	✓	✓	✓	✓



U.S. Department of Transportation
Federal Highway Administration

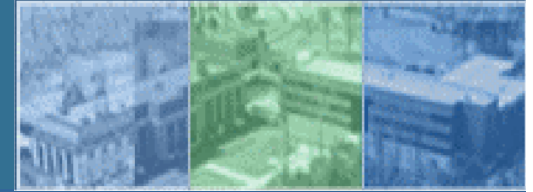
... NDE/SHM of Bridge Superstructure, Substructure, AND Pavements



How do we disseminate results?

- Structural Materials and Testing (SMT) Conference
 - Bi-annual conference sponsored by NDE Center and ASNT
 - Sessions in Concrete NDE, Steel and Cables NDE, Bridge Deck NDE, Pavement NDE, SHM, Bridge Inspection
- Transportation Research Board Annual Meeting
 - Technical presentations
 - Committee presentations AFF40 & AFF(40)1 - NDT Subcommittee
- FWHA Reports
- Technical papers and presentations
- Articles in Transporter and TRB magazines



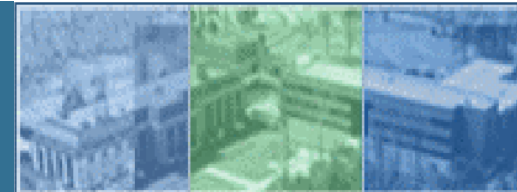


How do you secure your research results?

- Staff Computers – All laptops with dedicated backup units
- Lab Computer – desktop computers
- Network Server – NDE Common
 - All lab and staff computers are networked together
 - Weekly and incremental backup of the Server
- Parallel Machine
 - Connected to external hard drive with weekly backups
 - Connected to Emergency Power and UPC



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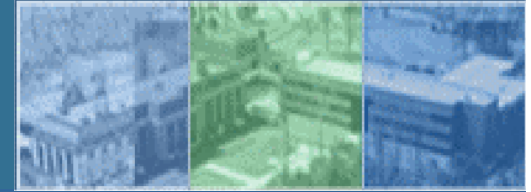


How do we conduct research?

Funding Source	Research Project
Steel Bridge <i>Testing-SAFETEA-LU</i>	Detection of Growing Fatigue Cracks in Steel Bridges
Advanced Research Funds	Nonlinear Dynamics (Chaos Theory) Analysis of Highway Bridges
General NDE Funds	Bridge Inspectors NDE Showcase (BINS)
	Development of Web Manual
	Bridge Decks–Detecting Delamination/ Corrosion in Concrete Bridge Decks
Pooled Funds	TPF-5(088) -Rapid Load Rating of WV Bridges with Drexel U. Now at Phase III.
	TPF-5(088) - NDE/NDT for Highways and Bridges
EarMark-SAFETEA-LU	Continued Development of an Advanced Bridge Deck Evaluation Technology Utilizing GPR with U. of Vermont (PERES II)
Internal Co-Op	TFHRC Internal Co-op., Rapid Response, and Special Projects in NDE
NRC Post-Doc	Thermoreflectometry for Corrosion Detection in Concrete



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Fatigue Cracks in Steel Bridges

- Crack Detection Technologies
 - Crack Size
 - Depth
 - Orientation
- Crack Growth Technologies



Olympus



Foerster



JENTEK



Physical Acoustics



MATEC

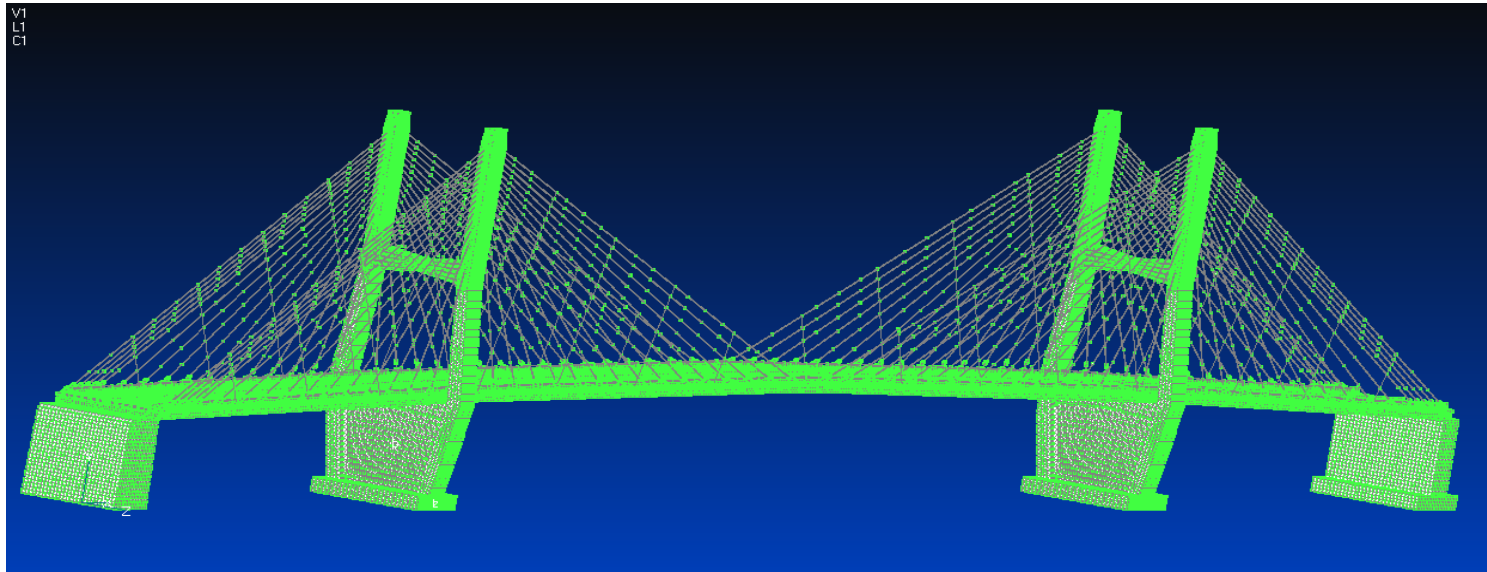
Research Approach:

- Commercial Equipment
- Research System Prototypes

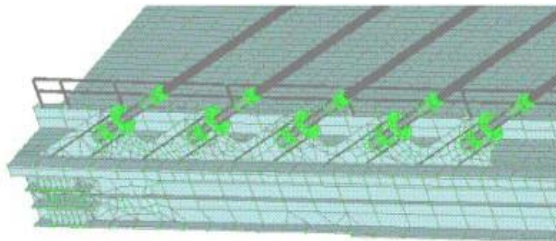


Nonlinear Finite Element Bridge Model

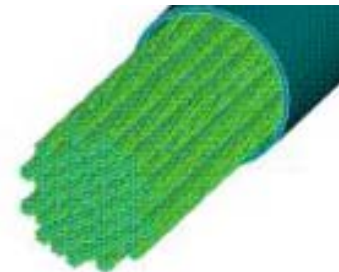
Bill Emerson Memorial Bridge (cable-stayed bridge)



Sample view of the detailed bridge deck, edge girder and stay cable system



Sample view of the bridge stay cables



The nonlinear bridge model consist of detailed FE modeling for structural joints



Multi-Sensor Approach:

- System Integration
- Data Fusion
- Scanning/Imaging

(PERES / HERMES FHWA-NDE Center)



(PSPA – Geomedia R&D)



GPR/Half Cell : Corrosion/Moisture IE/Chain Drag: Delamination



(IE Stepper – BAM, Germany)

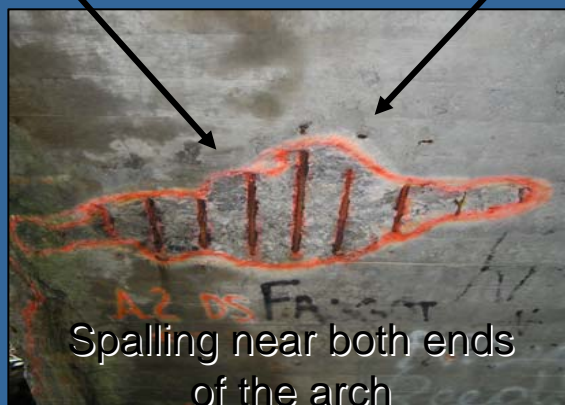


NDE Center *(3d-radar--Norway)*
Federal Highway Administration

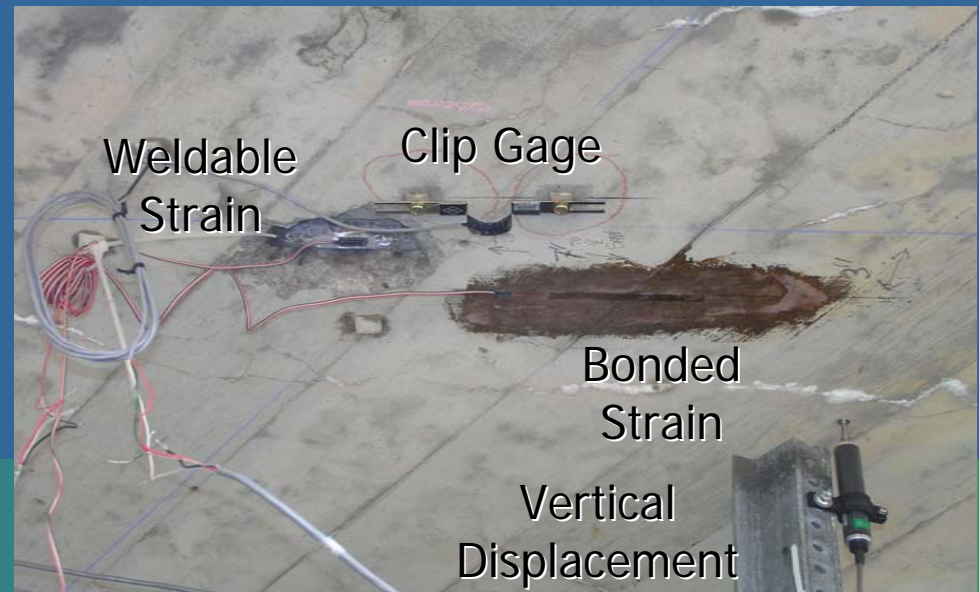
TURNER-PARK BANK-HIGHWAY CRESBARK CENTER



Amigo Arch



Tams Slab Bridge



U.S. Department of Transportation
Federal Highway Administration

Ralf Arndt: Microwave Thermoreflectometry for corrosion detection using induction heating of rebars

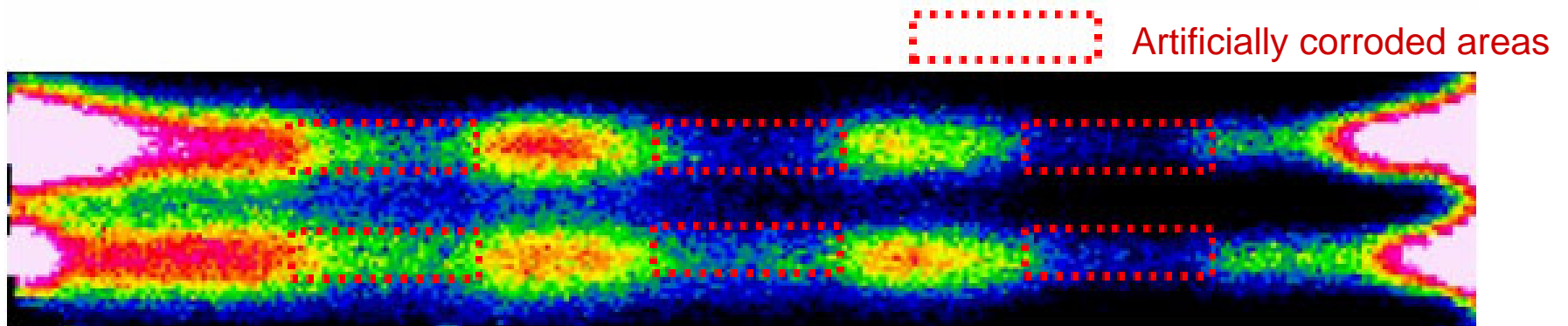
Principle:

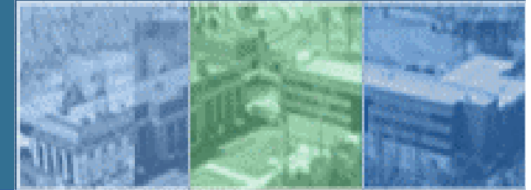
- Rebars are heated inductively without direct heating of concrete
- In corroded areas, heat diffusion is delayed in concrete, rebars are “hotter”
- Using microwave wavelength instead infrared to measure temperature signal of the rebars

Idea:

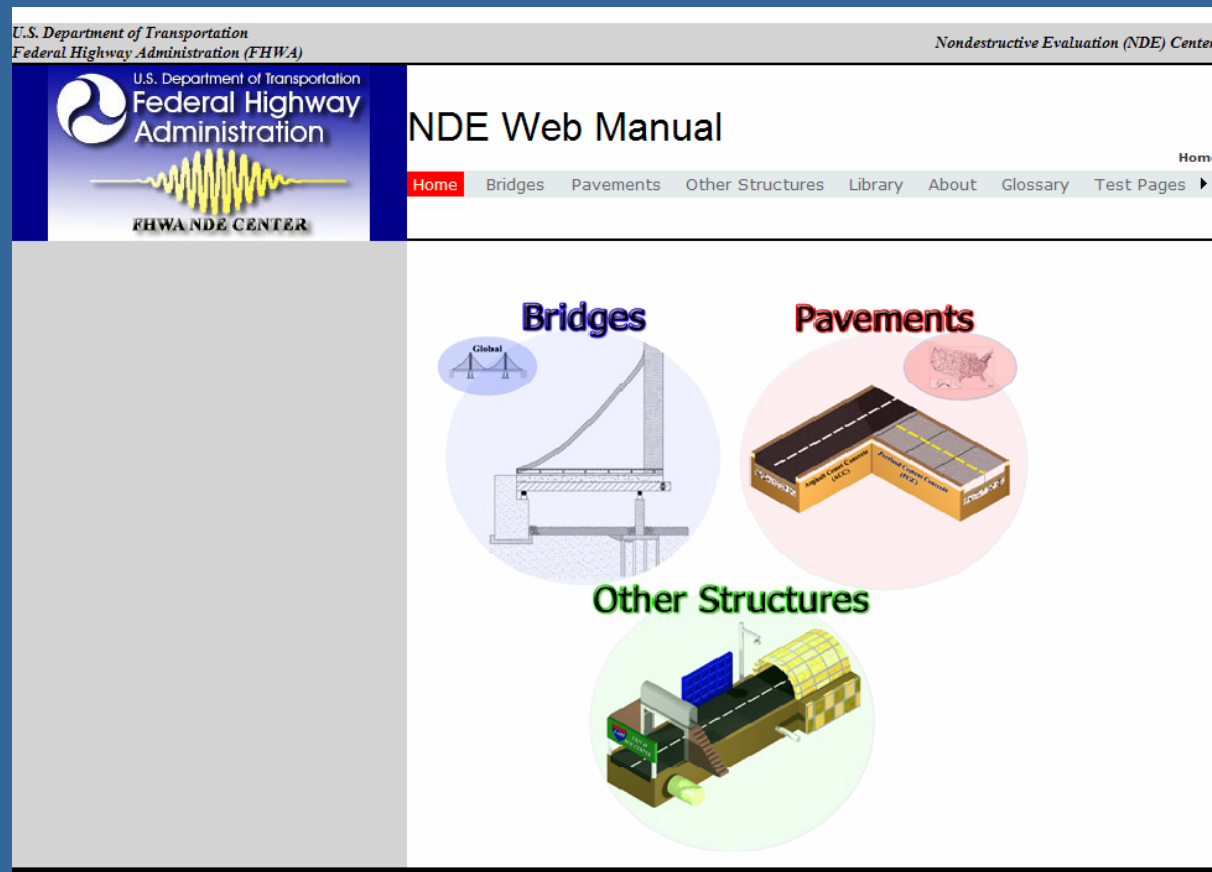
Fast and direct method compared to surface IR

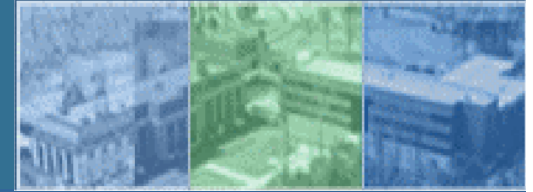
Main Problems: Finding and optimizing inductive heat source and microwave camera and signal processing of microwave data (very low SNR expected)





Stakeholders Outreach Programs



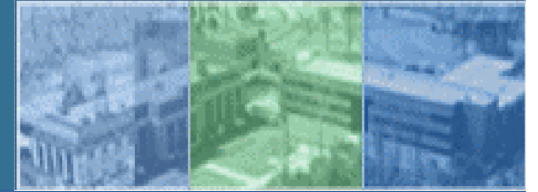


Stakeholders Outreach Programs

Bridge Inspectors NDE Showcase (BINS)

- Single day informal training on 5 NDE systems
- 5 NDE technologies
 - Eddy Current
 - Ultrasonic Testing
 - Impact Echo
 - Infrared Thermography
 - Ground Penetrating Radar
- Demonstrations of each system
- Static displays of systems



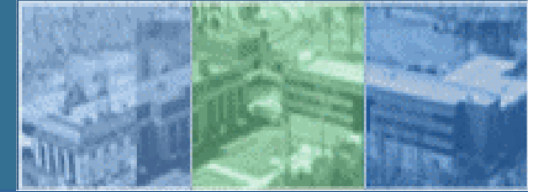


Thank You for Your Attention

... Project Demos!



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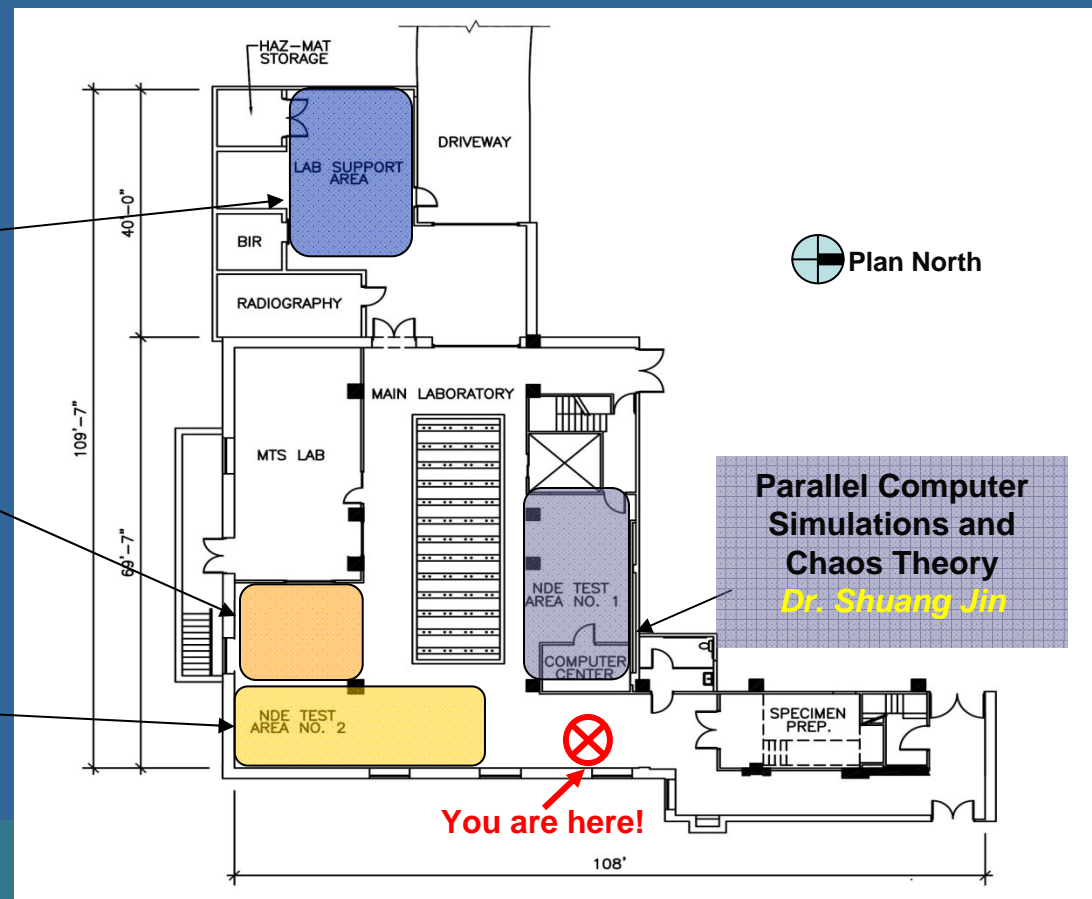


NDE LAB DEMO STATIONS

**Microwave
Thermoreflectometry
for Corrosion Detection
in Concrete**
Dr. Ralf Arndt

**Growing Cracks in
Steel Bridges**
Dr. Paul Fuchs

**Detecting Cracks in
Steel Bridges**
Dr. Ali Rezai



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